THE

COLLODION PROCESS.

BY

THOMAS H. HENNAH.

SECOND EDITION.

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PREFACE.

THE object of the present little pamphlet is to lay before its readers, in a plain manner, the method of taking pictures by the collodion photographic process; and as to render it really useful in that respect, it is thought necessary to confine attention to one direct course, rather than to offer a pointless summary of all that has been published, no other choice is open than to give the result of personal experience. In doing so fear is entertained that prejudice may so far exert its influence as to cause much that is useful to be passed over; and what is still more to be feared, much that is useless to have undue weight given to it, still for this the apology must be accepted, that for all that is wrong or wanting, the writer suffers as much as those whom he may mislead, nothing he practises being omitted, and nothing he has reason to condemn being mentioned.

With regard to the means of availing ourselves of the most valuable property possessed by the collodion *negatives* (their power of yielding an unlimited number of prints or proofs fac-similes of each other), a different course has been pursued, such that the writer knows to be good but difficult being omitted, to give place to methods more simple and easy, although it may be not quite so perfect in the end.

It would be ungrateful were the writer to omit offering his warmest thanks to the many kind friends to whom he has been indebted for his photographic knowledge and success, and for the royal road they have made for him by the readiness with which they have given him the benefit of their hard-won experience. When all have done so much it may seem invidious to mention any, still he cannot refrain from again thanking Mr. Berger and Mr. Eden for the many services they have done him, and of which he every day experiences the benefit.

That indulgence will be shown to what is necessarily imperfect, and that those who discover errors will, by pointing them out, enable him to avoid them in future,

Is the earnest hope of their obedient servant,

THOMAS H. HENNAH.

BRIGHTON, JULY 4, 1854.

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COLLODION PROCESS.

INTRODUCTORY REMARKS.

1. The great and increasing interest so generally taken in Photography, particularly in the most recent and beautiful process of all, that by Collodion, has induced the author to give a few directions which, as the fruit of long experience, he trusts will enable those who desire to practise this valuable art, to obtain with certainty most beautiful pictures, capable of multiplication to an unlimited extent, and of surpassing delicacy and truth.

2. From the conviction he has for some time felt that most of the difficulties complained of by beginners are of their own making, and owing more to ignorance of the proper method of manipulation to be pursued than to any other cause, he is sanguine that if his directions are as faithfully followed as they are honestly given they will be the means of helping many to a like success with his own; and while affording a means of useful and fascinating employment, will place at their command an art, the resources of which in aid of the artist, the antiquary and the naturalist, are as inexhaustible as they are, comparatively speaking, unappreciated.

3. He would not be understood as claiming the merit of originating the whole course of manipulation here given as being most conducive to success; for, from the progressive nature of the subject, he has been obliged to avail himself largely of the labours of others who have bestowed much time and attention upon it; all that he has attempted has been to give in their plainest form, and in good faith, those methods

which a course of careful experiments and successful practice, pursued for some time past, has enabled him to point out as reducing the collodion process to a state of absolute certainty.

4. Should any one be inclined, however, to find fault with the manner in which apparently trifling details are dwelt upon, he is reminded, that by following and applying the directions given, even those who are novices are almost sure of success, while those who neglect them as unnecessary throw discredit upon their pursuit and upon themselves by their failures.

5. The agent by means of which, from its extreme sensitiveness to light when properly charged with certain of the salts of silver, such beautiful pictures are to be obtained, has not been long known. It is a solution of gun cotton in alcoholized ether; and as all photographers ought to know how to prepare it for themselves, the following methods are subjoined. Before proceeding, however, the writer would premise that the opinions as to the different methods of iodizing, &c., are not hastily expressed, and that every formula has been put to the test of repeated and careful experiment; but still, owing to the uncertainty inseparable from all things with which time, temperature, or manual skill have much to do, it is possible that the same results may not follow the same course of proceeding with any two operators; forbearance should, therefore, at all times be shown to those who attempt to teach, although it may be unsuccessfully.

PREPARATION OF THE SOLUBLE COTTON.

6. First Formula.—Powder, *coarsely*, 8 ounces of pure crystallized nitrate of potash, and after placing it in a basin or broad-mouthed stoppered bottle, pour upon it one pound of sulphuric acid, sp.g. 1·820, and then, when it has been stirred with a glass rod to ensure perfect mixture, immerse in it without delay, by the same means, a quarter of an ounce of clean carded cotton, by small portions at a time, taking care that the whole

is thoroughly and intimately mixed together. When it has remained at rest from ten to fifteen minutes, remove the cotton, by means of glass rods, into a large vessel of water, and by stirring briskly, and renewing the water repeatedly, until it has no perceptible taste, wash out the whole of the acid and every thing soluble; then wring it in a cloth, and after loosening it by pulling the flocks apart, dry it by hanging it up in a net where it can be exposed to a current of air.

7. The time taken in washing out the acid, &c. (particularly the first wash), influences greatly the solubility of the cotton, and its fitness for photographic use. If it is allowed to remain in either of the first two waters, or if it is dried slowly, it will, in all probability, produce an inferior collodion, and be unequally soluble, while, if the waters are quickly changed, and it is dried rapidly, it should dissolve in a mixture of five parts ether and one of alcohol, sp. g. 0832, with scarcely any residue; and the collodion should be so tough as to allow of its being rolled off the glass without difficulty. If properly prepared, that is, if the nitrate of potash is pure, the acid of the proper strength, and both well mixed, the cotton thoroughly imbued, and afterwards carefully and quickly washed and dried, the film produced by the evaporation of its solution in alcoholized ether should be perfectly equal and transparent in appearance, and quite free from marks, or crape-like lines, even when almost dry.

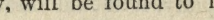
8. To the cause of change here pointed out (the influence of imperfect and slow washing and drying), the writer believes is due most of the difference observed between cotton prepared in large and in small quantities. An experimental portion is probably prepared in small quantity; the washing and drying rapidly and thoroughly performed, and the product is quite satisfactory; but upon carrying out the process on a larger scale, this *thorough* operation is not so practicable, and the result is not so good.

9. Second Formula.—This, which was kindly communicated to

the writer by Mr. Williams, is, from the nature of the materials employed, much more uniform in its product, and (particularly by the amateur) capable of being put in practice with more ease and less risk than the first.

10. Take of sulphuric acid, sp.g. 1·800, 120 measures; colourless nitric acid, sp.g. 1·440, 60 measures; and of fuming red nitric acid, sp.g. 1·460, 30 measures. These are to be placed in a broad-mouthed stoppered bottle, and Swedish filtering paper is to be immersed in it, in the proportion of 12 grains to every measured quarter of an ounce of sulphuric acid in the mixture. It is to remain in the mixed acids twenty minutes, and is then to be quickly washed and dried, as was recommended for the cotton.

11. If this is all carefully done as directed, and no waste is allowed, the paper, when dry, will be found to have increased in weight nearly 75 per cent., to have assumed the crispness and appearance of parchment, and from being perfectly insoluble to be as perfectly soluble in the mixture of alcohol and ether.

12. To prevent the paper matting together, and to facilitate the equal action of the acids upon it, it should, previous to immersion, be cut into strips about an inch broad, and then crimped across in this manner 

13. Whichever of these methods is followed, the operation must be conducted either out of doors, or in some place where the acid fumes (which are copiously generated, and are exceedingly injurious if inhaled) can be immediately carried off. The hands, by coming into contact with the mixture, would be stained yellow; glass rods should always therefore be used. The smallest quantity falling on to any article of dress would produce a hole in a short time; and even the first two or three waters in which the cotton or paper is washed would stain, and in time destroy anything upon which they may be splashed; on this account the whole should be thrown away as soon as it is done with.

14. In making choice of the cotton (or paper), the operator should have in view the particular purpose for which he requires it; that is to say, whether he wishes to keep it on the glass, or transfer the film to paper or wood after receiving the image. If it is to be transferred, cotton *perfectly soluble* should be used, from the facility with which it leaves the glass; but for beginners, or when it is to be kept on the glass, either cotton that is *not entirely soluble*, or paper that is soluble with difficulty, is the best. As far as the writer's experience goes, he believes that in most cases those collodions prepared from *imperfectly soluble* cotton (or paper) become attached to the glass with great tenacity, while those in which a perfectly soluble cotton is employed are with difficulty kept upon it. The last remark refers more particularly to *cotton* than *paper;* the difference is, however, only in degree.

PREPARATION OF COLLODION.

15. A mixture is to be made of 5 measures of washed ether, and 1 of alcohol, sp.g. ·832, and to each measured ounce of the mixture from 3 to 6 grains of prepared cotton or paper are to be added, shaking the whole together at intervals until a solution is obtained, which, if the cotton is good, will be very quickly.

16. No exact proportion of cotton can be specified on account of the varying solubility of different samples, and also for the reason that a different amount of thickness or viscidity is produced by equal weights of almost every separate preparation; but it may be taken as a rule that the cotton, of which the smallest quantity is required to produce a given amount of viscidity, is that which will produce the best pictures in the end.

17. A stock of this plain or uniodized collodion may be prepared sufficient to last three or four months, as it will by standing become clear, and be always ready for immediate use; much beyond this time it will (if originally fit for photographic uses

not keep good, and those who are unfortunately tempted to lay in a large stock for use abroad, &c., will find themselves sorely disappointed when they attempt to use it. It becomes *short*, and wanting in continuity, producing a granular and poor film, incapable of receiving definition. The writer does not say this from limited experience, he having lately tried collodion from almost every house in London, which he has had by him for some time, and which in every instance, without exception, he found perfectly useless. He speaks thus plainly, to avoid the loss and disappointment which must be felt severely by those proceeding to a distance, relying upon its remaining uniform, and finding that, perhaps, after a long journey has been taken with a view to its use, the main object is frustrated by its failure, when no means are at hand to replace it.

18. To the preceding methods the writer is enabled, by the kindness of Messrs. Simpson and Maule, to add the formula for the preparation of the collodion supplied by them to him, and which although rather difficult to put in practice, forms a collodion of most excellent quality.

Preparation of the cotton,

Powdered nitre	20 ounces.
Sulphuric acid, sp.g. 1·840 .	30 ounces.

19. Mix well together, and add by small pieces at a time, 1 ounce of the finest carded cotton wool, keeping the mixture stirred all the time (red fumes should not be given off); after stirring for fifteen minutes, take out the cotton and wash it thoroughly and rapidly until perfectly free from acid; finally, dry at a temperature not exceeding 150° Fah.

20. The cotton thus prepared is never perfectly soluble, but the amount of residue is constant if the operation is carefully performed.

Rectified ether,	sp. g. 1·750	2lbs.
Pure alcohol .	sp. g. 0·810	4 oz.
Gun cotton		½ oz.

21. After putting in the cotton shake well for a few minutes, and

allow the collodion to stand for twelve hours, shaking frequently during that time. When the collodion has become clear pour it off from the residue.

22. The quantity of cotton above given corresponds very nearly to 4 grains to every fluid ounce.

23. By whichever means the collodion is prepared, it is to be iodized, or made useful in photography, by adding to it the following solution in the proportion of one dram (fluid) to seven of plain collodion.

Alcohol . . .	sp. g. ·832	1 fluid ounce,
Pure iodine of potassium .		32 grains,
Pure iodine		1 grain,*

These are to be mixed together in a stopped bottle, the iodide of potassium having been previously reduced to powder, and, by shaking at intervals, a solution will be obtained which should be filtered through bibulous paper, and as an additional precaution against the entry of insoluble matters into the collodion, the bottle in which it is kept should not be disturbed for some time before any is removed for use; in fact, this precaution is most necessary, both with regard to the iodizing solution and the collodion, if very rapid action is required, as it completely prevents the necessity of waiting, after iodizing, for the collodion to become clear previous to use, and so, by enabling us to avail ourselves of the extreme sensitiveness of newly iodized collodion by using it at once, affords us the opportunity of securing many portraits of children and representations of moving objects which could not in any other case be obtained.

24. The sensitiveness of collodion is found, in every instance, to diminish slowly but steadily from the time of its being mixed with the iodizing solution, but although pictures are produced rapidly in proportion to the newness of the collodion, the same perfection of finish and tone is not so easily reached, at first, as when a day or two is allowed to intervene.

* This addition is not always necessary, its chief use being to prevent the cloudiness observed at times when newly mixed collodion is used.

25. The influence of this change on the character of the pictures produced is worthy of the closest observation; and as to the novice in photography, example may be better than precept, the writer will repeat, from a former edition one of the instances which occurred to himself. He took on the same day, as nearly as possible at the same time, two pictures, to one of which he gave two seconds' exposure, to the other forty, and in both cases the results were equally good. Now the only difference in the preparation of the glasses, was, that for the first, collodion only three days old was used, while that used for the second had been mixed more than six weeks. It is necessary to add that both samples of collodion had been prepared in the same manner, and from the same chemicals.

26. When the operator is without experience in the working of his collodion, he will save time, temper, and materials, if, in the first instance, he takes two pictures of the same object, giving to the first, if the light is tolerably good, from one to four seconds' exposure, and to the other, from thirty to forty. The difference of their appearance after, and while developing, will be the best guide to the time to be allowed in future trials.

27. Much error has arisen from this fact of the varying sensitiveness of collodion, and the great difference of result according to the length of exposure to light. To these causes the writer attributes the conflicting opinions expressed on the merits of different iodizing and bromizing solutions, and their power of rendering half tones perfectly, the real fact being, that by giving a short and a long exposure to the very same collodion, either a perfect absence, or as complete a superabundance of half tone, is obtained in the photograph, and when a comparison has been instituted, in nine cases out of ten the experimenter has either been led away by novelty, or the iodized collodion has not been quite fresh, while the bromized has, on the contrary, been perfectly so.

28. In this view of the matter the writer is confirmed by many comparative experiments, and from them he is led to believe

that, although, perhaps on the score of rapidity of action, the balance slightly inclines to bromized, it still possesses so many defects, that it cannot bear comparison with iodized collodion, and that, for all cases of portraiture or general use, where uniformity of action is desirable, the formula he has given for iodizing, and which he invariably uses, is as perfect as any at present known.

29. Iodide of ammonium is, unfortunately, difficult to get good, and is, even when obtained pure, too unstable for general use, but for these objections, it would be preferable to the potassium salt, on account of its leaving in the bath, by decomposition, nitrate of ammonia instead of nitrate of potassa; the reason for preferring the former will be mentioned in the chapter on the bath.

30. The method proposed lately by Mr. Crookes for restoring the sensitiveness of old collodion and preserving that of new, by immersing in it a piece of silver foil, is as valuable as it is simple. Collodion becomes slow in action principally from the liberation of free iodine by the decomposition of the iodide of potassium contained in it. Metallic silver combines readily with free iodine when brought into contact with it, forming iodide of silver, which is soluble in a solution of iodide of potassium, and as the object of iodizing collodion is to enable us eventually to form an iodide of silver, it follows that, instead of anything being lost by the combination of the iodine with the silver, our work is in fact anticipated, and that in proportion to the quantity of iodine liberated; combined with silver, and again dissolved by the remaining iodide of potassium, so is the quantity of silver required from the bath to excite the plate diminished.

31. Unfortunately, however, this, like many other good remedies, goes a little too far. It is necessary to the perfect working of collodion that a minute quantity of free iodine should be present in it on account of its power of preventing fogging, or cloudiness, and in practice it will be found necessary to add sufficient tincture of iodine to effect this; generally, for nega-

tives, about a drop to the ounce of collodion will do, or if for positives two or three drops, but it must be remembered that it is only in case of the complete removal of the iodine (which may be known by its losing the usual yellow tint), that this addition must be made; at other times it will do more harm than good.

32. A remarkable and almost unaccountable difference is commonly observed in the degree of sensitiveness to light of different samples of collodion, independently of the iodizing solution used. When prepared apparently under the same circumstances, iodized in the same manner, and at the same time, in one instance so much as four times the exposure was required for one than for another, and what is also remarkable, the least sensitive has invariably been that which most slowly showed the colour due to the liberation of iodine. It was for this practical reason that the writer, on a former occasion, did not entirely concur in Mr. Crooke's observations, a proceeding which he has learned excited some surprise at the time, although since warranted by the experiments of others leading to the conviction that too much tress has been laid upon the benefit to be derived from using collodion, free from iodine, when rapidity of action is sought after. It is doubtless of consequence that much should not be present, but the writer believes that to some hitherto hidden cause must be attributed the rapid diminution of sensitiveness observed in collodion after its being first iodized. He has frequently added a large proportion of tincture to newly mixed collodion without materially altering its action in any other way than in the production of clearer negatives.

33. It may be expected that something should be said as to the use of iodide and bromide of iron in collodion, but the writer has to confess to a complete failure in all his attempts at making a practical use of them; as, however, many whose names he respects much, have spoken in their favour, he can only attribute to his own carelessness or want of skill the difference of his

results from theirs, and must leave to other hands the task of working out their theories.

34. Since the foregoing was written, Mr. Shadbolt has added to the list of thoroughly useful and practical suggestions, for which Photographers are indebted to him, one for the use of chloroform in collodion for the purpose of making it more sensitive, and at the same time considerably enhancing its power of rendering half tone.

35. It is to be added in the proportion of twenty to thirty minims to each ounce of collodion. In the writer's experience, it has increased the rapidity of his collodion at least one-half, but, except in the case of having a collodion which gives hard and intense negatives, he thinks the above proportion too great, from ten to fifteen being sufficient, the larger dose lowering the intensity so much that the resulting proofs are wanting in vigour and brilliancy.

36. As collodion is the only requisite to the photographer, upon the preparation of which many observations will be made, the writer trusts that he will be excused for the space he has given it, and will proceed at once and more briefly to the consideration of what remains.

CHOICE AND PREPARATION OF THE GLASS.

37. Glass, known in commerce as "patent plate," should be chosen free from scratches, perfectly even, and well polished, then after having cut it into squares, so as to fit easily into the camera frame, the edges should be roughly ground, in order that the hands may be protected from injury, and that the adhesion of the film of collodion to the glass may be rendered more perfect than it would be without this precaution; indeed, with some samples of collodion prepared from cotton, it is almost impossible on unground glasses to keep the film perfect through all the washing it has to undergo, the water making its way underneath, disturbing it completely, and of course rendering

useless all previous care and trouble (if such a word can be admitted by a photographer.)

38. The necessary articles for cleaning the glasses are a few linen cloths (fine diaper is the best material from its being more free from flue than other kinds), an old piece of cambric and some nitric acid diluted in the proportion of three parts water to one of acid, or what some may prefer as the best, a mixture of tripoli powder with alcohol, of the consistency of cream, and to which may sometimes be added a small quantity of ammonia.

39. The cloths should be scrupulously cleansed from all impurities by boiling them in a solution of common kitchen soda, and then washing them several times in clean water, care being taken to avoid the contact of grease at all times. When thus prepared, they should be carefully kept from those used for wiping the frames, &c., and should not be used for any other purpose than those for which they are first appropriated. In fact, as it is upon perfect cleanliness that success so much depends, so is it impossible to carry attention to it too far, if we are desirous of overcoming quickly what might otherwise prove a difficult and tedious task.

40. The best method of cleansing the glasses is the following:—Pour a small quantity of the dilute acid or tripoli upon the glass, and with the fingers rub it well over both sides, then either hold it under a tap or rinse it in a basin of clean water, and before it has had time to dry spontaneously rub it well with one of the prepared cloths until all moisture is removed, and finish with a perfectly dry cloth, in which it must be held all the time, so that the hands may not come in contact with it.

41. By breathing occasionally upon the glass, and holding it so that the light may strike it obliquely before the moisture of the breath has quite evaporated, you may readily ascertain if it is sufficiently clean, any streaks or stains can be thus at once perceived, and may be removed by breathing hard so as slightly to moisten the glass and again rubbing it with the dry cloth. When the marks of the breath disappear smoothly and evenly

you may be sure that the glass is clean enough ; all that is then necessary is just, before coating the plate, to remove, with the piece of cambric, any dust or flue which may be upon it.

42. For small glasses the foregoing method is easily put in practice, but for large ones some precautions must be taken to prevent their being broken by the rubbing they have to undergo.

Fig. 1.

43. The little piece of apparatus represented in Fig. 1, the invention of Mr. Naylor, will be found most convenient as a means of avoiding such an accident. The plate is to be laid upon it, and while one end is held under the bevel at the broad end of the board, the sliding piece of wood is pressed in until the glass is held firmly; to ensure which, the slide is bevelled at the end, and is made to move with sufficient friction to prevent its slipping while the plate is being cleaned. When the operation is finished it is merely necessary to withdraw the sliding tongue and the glass will be released. The glass may of course be washed and roughly dried before placing it on the polishing board.

44. Additional care is requisite when positives are being worked, many trifling stains which would not be noticed in a negative, being then made very visible. It is therefore as well, instead of cleaning the glass as above directed, to use a solution of cyanide of potassium (of the strength of 60 grains to the ounce of water), in the place of the nitric acid or tripoli, and after drying the glass, to finish with a little dry tripoli and a piece of linen or cambric quite free from grease.

45. After having taken a picture by the pyrogallic process, nothing but clean water is required for cleaning the glasses.

COATING THE PLATE.

46. This operation influencing so materially as it does, by the manner of its performance, the character, of the finished picture, is so purely a matter of delicate manipulation, that although

very easy in practice to those who have ever seen it done, is like most things requiring manual skill, much more difficult to teach by precept than example, and although in the following directions the writer has endeavoured to render intelligible to the beginner the method he thinks the best, he would nevertheless advise those who have the opportunity to get a little "viva voce" instruction from a friend as the best means of saving both time and collodion.

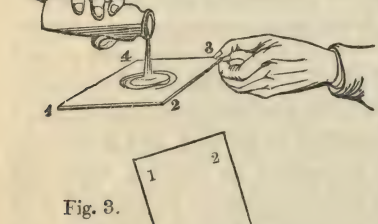


Fig. 2.

47. Hold the glass horizontally in the left hand by one of its corners, and pour the collodion on to the centre, Fig. 2, using a quantity sufficiently great to spread easily over the whole surface, by giving to it a movement of rotation, that is to say, incline the plate, so that the collodion may flow gently first to corner No. 1, then No. 2, then No. 3 (if possible avoiding the thumb), and then to No. 4. When the surface has been thus perfectly covered, return into the bottle from corner No. 4 all the superfluous collodion, raising the glass steadily, without haste, so that it may be vertical, in a line drawn from 2 to 4; then by raising corner No. 4, cause the lines formed in the collodion by the draining to run into each other, and leave an even surface, after which, return the glass to a horizontal position for a few moments. See Fig. 3.

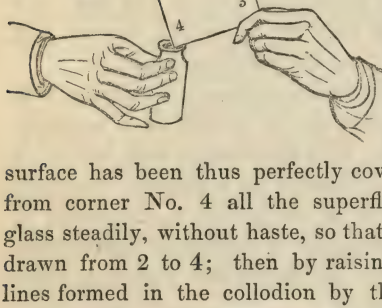


Fig. 3.

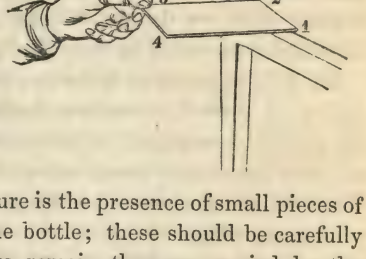
48. Some very experienced operators prefer draining from the opposite corner to that held (No. 1), but there is then the chance of any dirt or impurity upon the finger being carried right across the plate, while by the foregoing method it is retained at the edge.

49. When the glasses are so large and heavy as to be difficult

to manage without some support in addition to the fingers, they may be easily coated by resting corner No. 1 on the edge of a table or other convenient support in the manner represented in Fig. 4.

50. All necessary alterations of position can be made with ease without removing the corner from the table, and it will be found that the directions given above will apply equally well whether a support is used or not.

Fig. 4.



51. A frequent cause of failure is the presence of small pieces of dry collodion on the neck of the bottle; these should be carefully removed, for when suffered to remain they are carried by the collodion on to the plate, and these being partially dissolved cause large *striæ*, which inevitably spoil the picture.

52. Another precaution necessary to be taken when a large quantity of collodion is mixed at a time, is to preserve it in a large bottle and decant into a smaller one, a short time before using it, the quantity required for coating only a small number of plates. By this means the presence of the deposit which often forms at the bottom of the bottle is avoided, and with it the spots upon the picture which it causes. When, however, the care recommended when speaking of the preparation of collodion is taken, that both the iodizing solution and collodion are quite clear before mixing, little fear need be entertained that this cause of spottiness will be met with.

53. The operator must not immerse the plate in the sensitive bath until the collodion begins to set or become firm. The time to be allowed for this varies so much with the age and make of the collodion, and the state of the atmosphere, that no rule can be given as infallible. In general a dulness comes over the previously bright surface of the collodion, and indicates that it is ready for its bath.

54 If the plate is kept too long before immersion it will be unequally sensitive, those parts which were the most dry being least sensitive.

55. If the plate is immersed too soon, streaks and fringes, or as photographers call them curtains, will be observed proceeding from the edge of the plate at which the collodion was least dry. This is the most frequent error, and one more fatal to success than the opposite, but we must be careful in avoiding one mistake that we do not fall into another, but by observation learn the time suited to the collodion in use.

56. All the processes hitherto given may be performed by daylight; but in every subsequent operation, until the picture is fixed, the greatest care should be taken to exclude even the faintest ray of white light except that which acts upon the plate in the camera. The most practicable way of doing this is to cover the windows of the operating room with two or three folds of yellow glazed calico, light passing through a yellow medium having so little (if any) chemical effect that a large supply may be safely admitted, so much at least as to admit of all necessary operations being carried on with ease and comfort. It is a common error, and the cause of many failures and breakages, to suppose that our supply of even this light must be limited to barely enough to allow of our moving about.

57. Should the operator find it necessary to coat the plate by the light of a candle, he must be careful not to approach it too closely when doing so, the vapour of the ether contained in the collodion being highly inflammable. This caution deserves attention, several instances of severe accidents happening from its neglect having come to the knowledge of the writer.

EXCITING THE PLATE.

58. For this the following solution is required, in quantity proportioned, of course, to the size of the plate and the capacity of the bath:—

Take of nitrate of silver, 40 grains.
„ distilled water... 1 ounce.

59. Dissolve the nitrate of silver in the water previously placed in a stoppered bottle, and when the solution is complete add

n just sufficient water to dissolve it—iodide of potassium in the proportion of a grain to every five ounces of the silver solution. A precipitate of iodide of silver will immediately be thrown down, but this, by shaking the bottle occasionally so as to diffuse it thoroughly, will be nearly if not quite dissolved; in any case, after the lapse of ten or twelve hours, the solution may be filtered through paper, to remove all insoluble matters, and alcohol is to be added in the proportion of 30 minims (half a dram) to each ounce.

60. When the alcohol and silver solution have been well mixed by shaking, in all probability on exciting a plate with it good negatives will be produced; if such is not the case, it must be tested with litmus paper, and if any sign of acidity is shown, ammonia must be poured in, drop by drop, until the acid is neutralized, and a slight alkaline reaction is manifested; then glacial acetic acid, at the rate of a drop to every two ounces of solution, is to be added. It will, perhaps, be found advisable in most cases to make this addition in the first instance, even before trying the bath, on account of the additional security it affords; still, if we wish to go thoroughly to work, it will be better to test first.

61. The object of neutralizing any acid at first found in the bath, is to avoid the possibility of nitric acid being present, the writer having frequently, of late, experienced its prejudicial effects on the production of negatives, while, on the contrary, acetic acid, when present even in larger quantities than above stated, acts beneficially rather than otherwise; at all events, while ensuring *clean* negatives, it seems to diminish the sensitiveness of the plate but little, and for working out of doors, or in a strong light, is decidedly advantageous.

62. When after neutralizing the free acid in the bath, the ammonia is added in *slight excess*, a minute quantity of oxide of silver is thrown down, and this, when acetic acid is added, unites with it, forming acetate of silver, to the presence of which, with free acetic acid in his sensitive bath, the writer attributes much of his success.

63. If the collodion is ordinarily good, negatives produced from a bath composed as above have great intensity, and the deposit forming the lights of the picture is completely in, instead of on the film, and the negative will, if carefully used, yield many proofs, without being subject to injury although unvarnished.

64. The writer believes, that the addition of a small quantity of nitrate of ammonia will be found highly advantageous in keeping the surface of the bath and plates clean and free from stains, by its power of holding the oxide of silver in solution; but at the same time the bath must always have an acid reaction, the alkalinity, so much talked of lately, being, in many cases (as pointed out by Mr. Hardwick), due to the solution of oxide of silver in that salt rather than to the presence of any of the alkalies simply soluble.

65. The *fogginess* so frequently complained of is, when not owing to light having reached the plate, often caused by the presence of bodies acting as alkalies, the remedy for which is, the addition of acid (acetic) until the alkaline reaction is no longer recognised; but it is also very often caused by an excess of *nitric acid*, so diminishing the intensity of the negatives produced, that in order to obtain any force the development has to be carried on too long, that is until a general reduction of silver takes place over the whole surface, the consequence of which is, that the negative is generally very inferior in quality, and the resulting positives wanting in all freshness and vigour. In this case ammonia must be cautiously added, until the negatives are produced both clean and intense—a drop or two will in most cases suffice; if, however, too much is added, a general blackening will take place.

66. If a bath has been in use some time, and old collodion containing much free iodine been excited in it, a large accumulation of nitric acid liberated by the union of the iodine with the silver of the bath, will be found in it. This it is which gives rise to the state mentioned in the preceding paragraph, and which must be remedied as there pointed out. Beginners must not be deterred, however, by this statement from using collodion that

has been mixed some time, for it is by the use of this in a nearly neutral bath that the best negatives can be most easily obtained, subject only to less rapid action than when a more recent preparation is worked with, and the slight inconvenience of having occasionally to remove the acid produced.

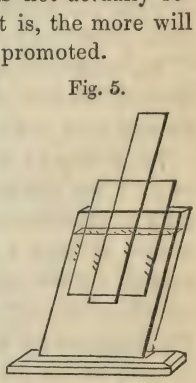
67. The characteristic of negatives produced from a bath containing nitric acid in any quantity is, besides transparency and want of depth, the greenish tint of the deposit when viewed by transmitted light whilst wet.

68. A general tone of reddish brown pervading both lights and shadows betokens an alkaline bath.

69. The bath, or rather the vessel for containing it, is best made of gutta percha or porcelain (glass, on account of its transparency, is objectionable), and should be of sufficient width to allow of a large quantity of solution being used; the false economy of using narrow baths being one of the most frequent causes of that inequality and cloudiness observed in collodion photographs. For a plate, 5 inches by 6, the bath should have at least the following dimensions:—$7\frac{1}{2}$ inches deep, $5\frac{3}{4}$ wide, and $1\frac{1}{2}$ across, and although a larger one is not actually required, still the larger (in moderation) that it is, the more will the equality and smoothness of the picture be promoted.

70. The dipper of which, with the bath, a cut is appended, Fig. 5, should be made of plate glass, a small slip of that material being cemented across the bottom to prevent the plate from falling off. This piece of apparatus should be selected with care, its greatest value arising from the fact, that its smooth plane surface when wetted enables us to bring the power of capillary attraction to our assistance for attaching the plate to it. This will not be the case if an uneven piece of glass is chosen.

Fig. 5.



71. About double the quantity of solution necessary for filling the bath should be made, so that by pouring it back into the bottle,

after use, it may be able to deposit any particles of collodion, dirt, &c., that may have got into it, and allow of a sufficient quantity being decanted off clear when wanted; this will be found in the end more economical than making barely sufficient to fill the bath, the loss by filtering (which would in that case be unavoidable) not being necessary; it is also of advantage, on the score of uniformity of action, as from its quantity it is not so liable to change as the smaller would be.

72. If the bath has a capacity of 16 ounces, 32 should be made; and if to this a supplementary bottle of solution is added, from which the loss by waste can be supplied, the operator may rely upon uniformity of action for months together. It will be found, that by keeping the larger bottle full (filling it from the smaller), that no addition of silver need be made to keep up the strength of the bath, the loss by conversion into iodide corresponding nearly with the quantity contained in the solution required for filling up.

73. After returning the solution into the bottle the bath should each time be well rinsed with water by half filling it, and then holding the dipper across its mouth so as to close it, shaking it well, repeating the operation two or three times.

74. Sometimes a more thorough cleaning is required, in which case a solution of cyanide of potassium will do it effectually, rinsing it of course afterwards with clean water.

75. It may be as well here to mention, that when the temperature of the operating room is below 60° Fah., the action of the bath is much improved by placing the bottle containing it before a fire, or into a basin of warm water, before using it; this remark applies equally to all the solutions, and to ensure *perfect working*, not only should the solutions be equally heated, but the temperature of the camera as well should be at the same degree, so that the temperature of the plate from first to last may not vary to any great extent.

76. When the collodion, as before mentioned, has slightly set, the coated glass is to be rested on the dipper, and immersed

steadily without any pause, every check given to the movement producing lines which appear painfully distinct on every proof that it yields. The dipper, before placing the glass upon it, should be plunged into the water for a moment to moisten it for the reason before pointed out.

77. The proper time for the plate to remain in the bath cannot be stated with precision, it is necessary as practised by most operators to allow it to remain undisturbed for about a minute, it may then with advantage be lifted out from time to time to ascertain the state of the film. *When the oily veined appearance, caused by the ether, gives place to a surface over which the solution flows freely and evenly*, the plate is ready for the camera. No harm is likely to be done by allowing an excess of time in this part of the process as the film is not injured by prolonged immersion when the bath has been prepared with the iodide as before recommended.

78. When the plate is removed from the bath, all excess of liquid should be drained from it, and after doing so it is advisable to wipe the uncoated side of the glass with a piece of clean linen rag, and also to place small pieces of bibulous paper at the corners of the plate frame before inserting the glass for the purpose of absorbing any liquid that may still drain from it. When thus treated, the plates are much less likely to stain, and the camera can be kept drier and cleaner.

79. When silver corners are added to the frames the blotting paper need not be used, unless indeed we are anxious to keep the camera clean, in which case a piece may be laid along the lower edge of the plate after placing it.

80. In concluding this part of our subject, the reasons for the use of iodide of silver and alcohol in the bath may be given.

81. The iodide of silver is added for the purpose of saturating the bath with that substance, and by doing so preventing its attacking and partially re-dissolving the coating of the iodide formed on the plate and so rendering the deposit unequal.

82. The alcohol is added for the double purpose of making the

plate more sensitive (which it does to a considerable extent), and of rendering the action of the bath quicker and more equal. The objection to its use is, that from the different amount of volatility of water and alcohol, the composition of the bath must be constantly subject to variation. The advantages to be derived from its use are, however, so great, that its want of steadiness must be disregarded, and by supplying the waste, by occasionally adding a little fresh, as much as possible remedied.

83. One of the results of Mr. Crook's industry has been lately given to the public. It is a process for keeping the colodion film sensitive for a length of time: it is subjoined in his own words.

84. The plate coated with collodion in the usual manner, is to be rendered sensitive in a 30-grain nitrate of silver bath, in which it should remain rather longer than is generally considered necessary (about five minutes), it must then be slightly drained and immersed in a second bath, consisting of

Nitrate of magnesia . . .	4 ounces.
Nitrate of Silver	12 grains.
Glacial acetic acid	1 drachm.
Water	12 ounces.

And there left for about five minutes, then removed and placed in a vertical position on blotting-paper, until all the surface-moisture has drained off and been absorbed; this generally takes about half an hour, and they may then be packed away in any convenient box until required for use. Not only is the sensitiveness unimpaired by this treatment, but we think, on the contrary, that it is slightly increased; intantaneous negatives have been taken on plates which had been prepared some days previously. We are not yet in a position to give the length of time that may elapse between the preparation of the plate and development of the picture; such experiments necessarily require a more lengthened period than we have at present been able to give, but as long as they have yet been kept (upwards of three weeks), there has been no appearance of deterioration.

85. Before the development, we find it advisable to moisten the collodion film by immersion in the silver bath for about half a minute, as otherwise the pyrogallic acid or iron solution would not flow evenly over the plate. The fixing, &c. is of course conducted as usual.

86. There are one or two circumstances to be attended to in the preparation of the magnesia bath. Commercial fused nitrate of magnesia is very liable to contain chlorine, and also to have an alkaline reaction on account of the fusion being carried too far. Of course the quantities of acetic acid and nitrate of silver given in the formula for the bath, are on the supposition that the nitrate of magnesia is pure; if this be not the case, it should be rendered perfectly neutral with acetic acid, the chlorine exactly precipitated with nitrate of silver, and then the proper amounts of acid and silver added. However, if the impurities are very considerable, it will be safer to reject the salt at once. This bath will keep in good order for a long time; the only point to be attended to is to drain the plates slightly after coming from the silver bath, and, if necessary, to remove the liquid from the back with blotting-paper, so as to introduce as little silver as possible into the nitrate of magnesia. A solution of one grain of silver to the ounce is quite sufficient to keep the plates sensitive; and when the strength rises, as it will in time, to above a certain limit, the slight evaporation that always take place will render the silver solution sufficiently strong to dissolve off the iodide in small holes. If this occur the bath can be restored by nearly, but not quite, precipitating the silver with a solution of chloride of magnesium, and then filtering.*

87. In this and the following operation it is scarcely possible to avoid staining the hands with the silver solutions. These stains may (if recent), be removed by first washing them over with a saturated solution of iodide of potassium, and then with nitric

* Vide Journal of the Photographic Society, No. xx. p. 6.

acid diluted, so as not to stain the hands yellow, that is to say with twice its quantity of water. The iodide does not itself immediately remove the stains but upon applying the nitric acid they soon disappear.

88. A more expeditious and effectual way is to rub tne stains with a lump of cyanide of potassium wetted with water, and as soon as they disappear wash the hands well to remove the cyanide. Care must be taken when using this salt on account of its extremely poisonous nature, and the injurious effects which follow upon its application to any part of the body from which the skin is removed. It must never be used if the hands are scratched or chapped, for in that case it will make its way into the flesh, a troublesome sore will be produced, and the loss of a nail may follow.

EXPOSURE OF THE PLATE.

89. The plate after being rendered sensitive by the last operation is to be submitted to the action of light in the camera with as little delay as possible. The time of exposure necessary for obtaining perfect results varies so constantly with the intensity of light, the power of the lens, and the state of the collodion, and the bath, that no rule applicable to all cases can be given; the operator must therefore now depend upon experience as his guide, for *it is only by the behaviour of the film under the action of the developing solution, and the character of the picture after developing* that he can judge if the exposure has been of the proper duration, and he should as soon as possible make himself acquainted with the appearance of the film both when over and under exposal, so as to be able at once to correct any error he may have been guilty of.

90. When a beginner, if a photographer wishes to produce photographs worthy of being called *pictures* he should lose no opportunity of learning the causes of the variation in tone and finish observed in the work of different operators, and by

finding out the sources of error as well as the means of success, enable himself to produce at will pictures of any character.

91. Difficult as this may at first sight appear it is not so in reality, and no one should be satisfied until he can command the photographic part of his art. When he can, although he may take a higher position than is deserved by those who have to trust to chance for a picture, he has still much to do before he will gain the name of artist as well as photographer.

92. It is not sufficient to place an object opposite a camera, and regardless of any thing but fine focussing to receive, and alas! perhaps perpetuate what may be an enormity. Close attention must be paid—whether we are taking a portrait, or view, or copying a work of art—to the selection of a good point of sight, arrangement of light, &c.; and instead of denying or concealing the fact of the distortion of all images of objects in relief when thrown by lenses upon a flat surface, we should always bear it in mind, and by employing lenses of long focus and moderate aperture, and by arranging our subject so as to be as much in one plane as possible, reduce the error to its lowest amount, in fact until it is practically scarcely to be called an error.

93. All this may be and is done by many photographers, and when to this is added an artist's skill in making the most of a subject by arrangement of light and accessories, and choosing the point of sight well, they may surely claim for themselves a better consideration than that to which the mechanical attempts and sorry productions of self-styled photographers had nearly consigned them.

DEVELOPING THE PICTURE.

94. For certainty and uniformity of action nothing has yet been found so generally applicable to this purpose as pyrogallic acid when properly used.

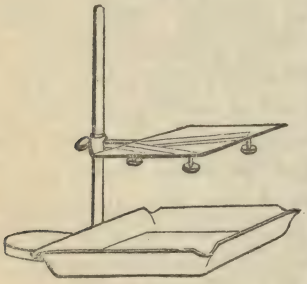
95. The developing solution for ordinary use should be made as follows:—

Pyrogallic acid	1 grain.
Glacial acetic acid . . .	5 minims.
Alcohol	10 minims.
Distilled water	1 ounce.

Mix, and filter through bibulous paper.

96. The plate, having been removed into the operating room—from which all white light must be excluded in the camera frame, is to be placed quickly and carefully upon the levelling stand, and a quantity* of the preceding solution having been measured into a clean glass, a solution of nitrate of silver (forty grains to the ounce of water) is to be added in the proportion of two drops to each dram. When these have been mixed by stirring with a clean glass rod, they are to be poured or almost thrown over the plate—taking care not to disturb the film—by moving the hand, holding the measure in a circular manner so as to disperse the contents rapidly and evenly over the surface, which dispersion may be assisted by blowing upon the glass with the mouth; this not only has the effect of rendering the application equal, but serves to keep in suspension the deposit which generally forms, and which if allowed to settle in any one place would spot the picture. The operator should not blow too long in one place, nor with sufficient force to remove the fluid entirely from any part of the plate—cloudy dirty marks being often produced by so doing; another cause of unequal development is neglecting to mix the pyrogallic and silver solutions together with adequate care.

Fig. 6.



97. It will be observed that the preceding solution is spoken of as that for ordinary use, and for ordinary and almost universal

* More or less according to the size of the plate.

use it is certainly the best the writer has tried. It may however happen, particularly when a new bath is in use, that it will not give intensity enough even when the collodion and other solutions are in good order. We must then (without exceeding three grains to the ounce) increase the quantity of pyrogallic acid by half a grain at a time until sufficient intensity is gained, at the same time adding a larger quantity of the silver solution.

98. If the wished for intensity is not procured by the additional strength of the solution some cause over which it has no influence must be at work, and must be sought for either in the bath, the collodion, or the *time of exposure.*

99. It frequently happens that instead of a want there is an excess of intensity; in this case the first step should be to reduce the quantity of, or even entirely omit, the silver solution. If this does not do, the strength of the pyrogallic solution must be diminished; but if neither of these remedies avail, longer exposure must be given. This last certainly prevents excessive intensity and hardness, and is perhaps more needed by the beginner than any other. The common error of allowing too short an exposure, giving rise to the condemnation of many really good collodions, and creating more disappointment than is generally supposed.

100. As soon as the fluid is applied to the glass the operator should watch the progress of development with the utmost attention, for as before said it is upon a knowledge of the appearance presented by the film of collodion both when under and over exposed, that the beginner will have to depend for ascertaining the time for allowing the plate to be acted on by light.

101. He must from time to time by holding a piece of white paper beneath the glass, or if practicable by looking up through it observe the amount of intensity he has obtained, taking the following remarks for his guide (until he has had experience) as to the time for arresting the action of the developing fluid.

102. If, upon pouring on the solution, the image appears tardily, and the high lights upon the portrait, &c., attain great intensity before the details of the dress are visible, and if after removing the iodide by the hyposulphite it exhibits a greyish appearance by reflected, and a perfectly opaque deposit in the high lights by transmitted light, *it has been under exposed.*

103. If, on the contrary, the picture appears quickly, the shadows coming out nearly at the same time with the lighter part; and, if after a time it begins to change all over; and lastly, if upon removing the iodide no picture is visible by reflected, and only a faint one by transmitted light, *it has been over-exposed.* The great want of contrast in over-exposed pictures is worthy of remark, the folds of black and white drapery being even in the same picture scarcely distinguishable by their intensity from each other. It is commonly the case, when a weak solution of pyrogallic acid is used in developing, and the picture is over-exposed, that a beautifully ruby-red colour will be observed on looking through it while wet, and it will be found that although it appears but of slight intensity it will yield very perfect positives, the red colour becoming when dry a rich transparent brown, and by so changing admitting of greater delicacy of tone and definition than when the same amount of intensity is obtained from a more opaque deposit. On this account it is of more advantage to over than to under expose, still from these very terms of *over* and *under*, it will be inferred that there must be some intermediate time of exposure more advantageous than that which would produce either of the results just described.

104. If upon developing, first the lights and immediately afterwards the shadows of the face, followed by the dress of the sitter, make their appearance, the deep shadows under the arms, &c., preserving nearly their original clearness, while the lights go on increasing in power, and after using the hyposulphite it exhibits a coloured bloom of red and green upon its surface, the principal lines being clearly seen when it is looked down upon, and when looked through, all the different parts of the picture are shown in

their proper (reversed) gradation of power, a small amount of transparency remains even in the highest lights, *it has had the right exposure.* Although the characteristics of a properly exposed negative are those given above, a considerable range of time may be allowed without producing an utterly useless picture; but the beginner must remember that it is always better to give too much than too little time.

105. At the risk of repetition, a few useful hints on this subject may be given in conclusion.

106. If a plate has not been much under-exposed, a tolerable picture may often be obtained if the developing fluid is not allowed to remain on long enough to render the lights perfectly opaque.

107. An under-exposed picture is also frequently made useful by varnishing, its intensity being diminished by so doing, while, on the contrary, we should avoid varnishing a weak over-exposed picture for the same reason.

108. If a plate has been over-exposed, it is of very little use trying to increase the intensity of the picture by continuing the action of the developing fluid long after it has begun to blacken equally.

109. When properly exposed, the action may be continued until the whole of the details are clearly seen by transmitted light, taking care that the lights do not gain too much strength.

110. The operator must not confound the effects of over-exposure with those following upon the action of light upon the film, either from the frame not being well made, or from the room not being sufficiently darkened. They are very difficult to distinguish; in fact, so much so, that experiment is needed by most operators to ascertain to which they may attribute their failure. If the frame fits badly, the cloudiness will generally be partial, while if white light gains an entrance into the room it will be more equal, and will resemble more closely the effect of over-exposure.

111. In most cases when over-exposed, the whole of the picture appears very quickly, and we see at first that it is the

image itself which is developing *altogether* so fast; while if the cloudiness and weakness are owing to the action of extraneous light, the image will appear at first slowly, and then it will seem as if a general deposit took place over the whole surface, veiling the picture completely.

111. The beginner will also find difficulty in distinguishing the effect of an *alkaline bath* from that of over-exposure and from that just mentioned. But, as in the portion relating to the bath, he is cautioned against its use, and recommended to have it at all times slightly acid. Time need not be wasted in describing what ought never to be met with.

113. When the development has proceeded far enough, the plate is to be removed from the stand and washed, by pouring a gentle stream of water upon its surface while it is held horizontally. This operation requires care; for if the water is poured from too great a height, or if the plate is too much inclined, the collodion will be torn from it; but if *common care* is exercised, this accident is not likely to happen.

FIXING TTE IMAGE.

114. After washing, the plate is to be immersed in a solution made as follows:—

Hyposulphite of soda . .	10 ounces.
Water	20 „

Sufficient of this solution is to be placed in a gutta-percha bath similar to that used in exciting; and after resting the plate on a dipper, it is to be plunged in, and allowed to remain until the whole of the iodide is dissolved.

115. The plate may be examined occasionally by lifting it out of the bath, and when it appears quite clean and free from veined markings, it is again to be thoroughly washed to remove every trace of the hyposulphite from it; for if from this being carelessly done any should remain, it will after a time crystallize and destroy the film.

116. It may here be observed that the above solution of hypo-

sulphite will serve for many plates, and must only be renewed when it becomes so saturated with iodide as to require too long a time to complete its action.

117. This application renders the plate insensitive to the action of light, and quickly dissolves the yellow iodide; while doing so the negative picture seems gradually to vanish, and then, if it has been well developed, to re-appear as a positive. It is important that the action of the hyposulphite should be continued long enough to dissolve out the whole of the iodide, for if not completely removed at first, it will cause an otherwise good negative to be perfectly useless, the collodion seldom being able to bear a second application of the hyposulphite after it has once dried.

118. The picture, after being drained and then dried by holding it at a short distance from a fire or by placing it in a draught of air, is finished, and may be printed from immediately; it is better, however, when the negative is of sufficient intensity to varnish it previously as a protection from injury.

119. In the event of the operator not being able to procure a supply of pyrogallic acid, he will find the protosulphite of iron a very useful substitute; it is, however, more difficult to obtain good pictures with it: the best method of using it is that proposed by Le Gray.

Protosulphate of iron . . .	500 grains.
Sulphuric acid	20 drops.
Acetic acid	100 minims.
Distilled water	10 ounces.

120. It should be placed in a glass or gutta-percha bath, and may be used for many negatives in succession until its reducing power is so far exhausted that it fails in developing the latent image. The muddy appearance it assumes may be disregarded, no ill effects resulting from it. The plate must be placed on a dipper as in exciting, and must be plunged quickly into the solution. In this there is no difficulty; but in watching the development, much care is required; for if the plate is kept too long out

of the bath it will be covered with veined marking, which cannot be got rid of afterwards: it should be lifted out but for an instant, and if it is thought to be sufficiently developed, is to be immediately washed, either by immersion or by a stream of water. If, however, the image is not sufficiently brought out, it must be replaced in the bath until the desired intensity is obtained.

121. Some operators, to increase the intensity of the negatives produced by using the solution of protosulphate of iron, pour over the plate a weak solution of nitrate of silver. This the writer has not tried; he cannot therefore state the necessary strength for the silver solution. In either case, after washing, the negative is to be fixed in the same manner as when pyrogallic is used, the persulphate of iron recommended by Le Gray for fixing being most uncertain in its action.

122. It must be borne in mind that the iron solution is useful as a substitute, and as a substitute only, for the pyrogallic solution, except when instantaneous pictures are attempted; it may then perhaps be considered superior on account of its doing away with a great deal of the harshness observable in many instantaneous pictures developed with the pyrogallic acid.

123. Many kinds of varnish have been recommended, all of which possess some merit. The writer prefers those made with chloroform: the rapidity with which they dry preventing the annoyance caused by the settlement of particles of dust on those which dry more slowly, and the ease with which they are applied making them also additionally valuable to the beginner.

124. Whatever varnish is used the plate must be perfectly dry before its application, and the drying must not in any case be attempted to be hastened by blowing upon it with the mouth, the moisture of the breath causing an opacity of the film not at all desirable. All the varnishes may be applied to the glass in the same manner as when coating it with collodion, and the above remarks may serve as a caution for all.

125. Mastic varnish (picture varnish) is most frequently at hand, and should be diluted for use with twice its quantity of turpentine.

126. Spirit varnish requires rather different management than do the others. Before its application the plate must be held before a fire until it is as hot as the hand can bear; the varnish is then poured on and drained off again into the bottle, and the glass, particularly if thin, is again to be held before the fire for a few moments, to keep up the heat until the spirit has all evaporated; for when the plate is allowed to cool before the spirit has left it, instead of a hard, bright, glossy surface, only a dull, rough one (similar to that produced by breathing on the chloroform varnish while soft) is obtained.

POSITIVE PICTURES ON GLASS.

127. In touching upon this branch of the subject the writer is obliged, in some measure, to depart from the course he had intended to pursue, namely, that of giving, instead of a compilation of the numberless methods, both good and bad, that have been suggested, only the one he had been led by experience to adopt. It being his opinion that the beginner at all events will be most benefited by having his attention directed to one course, instead of being bewildered by half a dozen, even if that one should not be the best.

128. As a rule the bath for positives should be more acid than for negatives, it is not however necessary to alter a good bath or to make a new one if *many* positives are not wanted, the effect of an acid bath being easily produced by adding two or three drops of tincture of iodine to each ounce of collodion; by this means almost any collodion will be made to give good positives. The exposure for positives is less than that required for negatives, and they can be obtained with an amount of light which, with any exposure, would be incapable of producing negatives.

129. The chief difference in the course to be pursued for obtaining positives and negatives lies, after exposing, in the development.

130. The method most nearly approaching that for negatives

is that suggested in the early days of collodion by Mr. Horne, and is even now thought by many to be the best. He merely adds to the ordinary pyrogallic developing solution a small quantity of nitric acid, a drop or even less to the ounce being sufficient; if the picture comes out greenish and wants depth and brilliancy, too much acid has been added, if on the contrary it looks brown and dull more is required, it must however be remembered, that the deposit always looks whiter when dry than when wet. On account of the necessity, in some cases, of using very small quantities of nitric acid, it should be kept diluted, so that a portion equal to no more than a fiftieth part of a drop or the strong acid may, when required, be added.

131. It will, with most kinds of collodion, be necessary to add to the developing solution some nitrate of silver, in the same proportion as recommended for negatives.

132. They may be fixed in the same manner as negatives, but more care must be taken to wash away all the developing solution before immersing the plate in the hypo, otherwise the acid contained in it will decompose the hyposulphite, and cause a blackening of the deposit, which, although not very injurious to negatives, would entirely spoil a positive.

133. The brilliancy and finish lost by drying when positives are obtained, either by this or any other means, is always restored by varnishing.

134. Far more brilliant, although to many not such pleasing positives, can easily be obtained by the following method :—Collodion rather thinner than usual is employed, and the plate is excited with the usual bath, and after exposing, not more than half the time that would be required for a negative, the image is brought out by immersing it in a bath made as follows ;—

Proto-sulphate of iron . . .	40 grains.
Nitric acid	2 drops.
Acetic acid	30 minims.
Alcohol	20 minims.
Distilled water	1 ounce.

The iron is to be dissolved in half the water, and when a solution is obtained, the nitric and acetic acids are to be diluted by mixing with the remainder, and are to be added to the iron solution; the alcohol may then be added.

135. No injurious effect arises from this solution becoming thick, as it does after being used two or three times; it is better however to filter it occasionally, and when not in use to preserve it from the air in a stoppered bottle.

136. In this, as in most other cases where positives are worked for, they may be fixed in the same manner as negatives.

137. The following method of M. Martin is much praised by French operators, and by many who have tried it here. Instead of the usual bath, one composed as follows is employed.

Nitrate of silver	40 grains.
Nitric acid	24 minims.
Distilled water	1 ounce.

138. After exposure the plate is developed by immersion in a bath of sulphate of iron, which, instead of M. Martin's formula, had, the writer thinks, better be the same as that recommended in the preceding paragraph. When sufficiently developed he washes it thoroughly with water, and then immerses in another bath composed of—

Nitrate of silver	12 grains.
Cyanide of Potassium . .	77 grains
Distilled water	7 ounces,

which will convert the negative picture into a positive.

139. It will often, in developing positives be found, that if sufficient exposure has not been given, that the picture develops slowly. When this is the case, instead of the blacks being pure and strong, a formation of small spangles of metallic silver takes place, after a time, over the whole picture, and of course spoils it. On the contrary, when over-exposed, the developing fluid acts so rapidly on the parts that have received most light, that it has to be

poured off before the half tones appear; in this case the blacks will be very strong and clear, but all definition will be lost in the lighter parts.

140. The development must not be carried nearly so far as when bringing out negatives; it should be stopped before the details are visible in the darker parts, on account of the colour of the deposit forming the picture approaching so nearly to that of the iodide already there, that until the unchanged portions are removed we cannot perceive all the detail in the shadows that may have been obtained.

141. Contrary to the fault of under-developing, so frequently committed when working for negatives, it is more frequently found, that good positives are spoilt by going too far, and that if we had not been so anxious to see all we should not have lost all, the effect of over-developing being to blend into one mass the light parts of the image to the extinction of most of the delicacy for which positives are prized.

PRINTING OR TRANSFERRING TO PAPER.

142. As without some instructions for making use of them, the negatives, towards the production of which so much attention has been directed, would be of no value, the writer has to offer from the many formulæ that have been proposed a selection of those most likely to be generally useful; he would at the same time wish it to be understood that in preference to those capable of giving brilliant results, but at the expense of much time and labour, he has chosen those which from their simplicity are most likely to be serviceable to the beginner, leaving to the more practised operator the task of working out the improvements he may think necessary.

143. There is a marked difference between papers manufactured in England and on the Continent, most of those made abroad having a large portion of starch in their composition, and from that circumstance affording black colours readily, while in

the English papers the starch is generally replaced by gelatine, and the black colours can only be obtained with difficulty. In many papers there is also a large quantity of chloride, which affects materially the results to be obtained upon them. One description made by Nash contains so much, that with no other preparation than brushing over a fifty-grain ammonio-nitrate of silver solution, very beautiful proofs are to be obtained. There is also a foreign paper which contains a larger quantity, at all events sufficient to render an alteration in the strength of the solutions necessary.

144. The apparatus required, need be neither complicated nor expensive, all that is actually necessary being comprised in the following list:—

145. A few pieces of stout plate glass rather larger than the pictures they are to be used in printing,—some plain, others having smooth black cloth evenly pasted over one of their surfaces.

146. Some drawing boards, on which to pin the paper when the solutions are applied by brushing.

147. Some flat dishes for applying the solutions, when floating is preferred to brushing.

148. Two or three brushes made expressly for photographic purposes.

149. Some dishes for washing the proofs after fixing them.

150. Bibulous paper.

151. When a sheet of paper has been rendered sensitive by either of the following means, it is to be laid, the prepared side up, on one of the covered glasses; the collodion negative is to be carefully placed, the coated side downwards, upon it, and then upon that one of the plain pieces of plate-glass, the weight of which will be sufficient to bring the negative into close contact with the paper. After having done this in a moderately dark room, remove it to where the light of the sun, or even diffused daylight, can have free access to it for a time, varying with the intensity of the negative and the light, until it is dark enough. It may

safely be looked at, by first carefully taking off the upper glass, and then while one end of the negative is pressed firmly on to the paper to prevent it slipping, the other is lifted just high enough to allow the progress of the picture to be seen. If it is not dark enough, the glass must be lowered down, and it must be again exposed to light.

152. Some difficulty may be found at first in returning the glass to precisely the same place it before occupied on the paper; a little practice will, however, soon enable the operator to do it successfully; and as so much of the beauty of the proof depends upon its having the proper amount of light, he must frequently inspect its progress: he will therefore do well to master this piece of manipulation as soon as possible.

153. The proof should always remain in the light until it is considerably darker than it is desired to be when finished, to allow for the loss it always sustains in the hyposulphite bath, and it should be borne in mind that an under-printed picture cannot be improved, while one that is too dark can, by prolonging the action of the hyposulphite, be reduced to almost any extent.

154. There are several ways of applying the solution to the paper; those most generally practised being either by the brush, or by floating the paper on a quantity of the solution placed in a flat dish.

155. When only small quantities of paper are wanted, it will generally be most advisable to apply the solutions by brushing, it being the most economical method. It will also be found that if a quantity of a solution is prepared, it will by brushing yield uniform results so long as any remains, while if applied by floating, a constant change goes on; so that when a comparison is made between the first and last sheets prepared, it will scarcely be possible to believe that the same processs has been followed.

156. The use of the brush has been much condemned; not, as the writer believes, from its being really difficult or wrong, but from the unnecessary cautions which have accompanied directions which have been given for preparing sensitive paper by its

means. The paper to be prepared should be pinned by its corners to a smooth drawing-board, having previously placed a piece of white blotting-paper somewhat larger beneath it to absorb any solution that may pass over the edge. The solution is then to be brushed freely over it, first in one direction and then in the other, crossing the strokes so as to ensure an equal coating, repeating the operation if any inequality is observed. Sufficient of the solution should be applied by brushing in the first direction, the subsequent crossing being for the purpose of rendering that equal. Very little practice will enable the operator to apply just so much that by crossing once or twice there shall be no patches unabsorbed. When free from running moisture, the paper is to be pinned up by a corner to dry.

157. It is not necessary to have the paper perfectly dry before applying the silver solution, more brilliant proofs being obtained by its being brushed on while slightly damp. After the silver solution is on, however, the quicker and more perfectly it is dried the better.

158. The operator must not be deterred by this caution from laying by a stock of salted or half-prepared paper, if so inclined, the difference being very slight; still, as there is a difference, it is thought right to mention it.

159. For floating the paper, a much larger quantity of the solutions will be required. They must be poured into a flat dish to the depth of about a quarter of an inch, and then the paper previously cut to the proper size is to be floated, by first placing one end on the fluid, while the corners of the other end are held by the fingers, bringing the whole gradually down upon it, and exercising sufficient pressure to prevent any air-bubbles from remaining. When the ends cease to curl up (generally after one or two minutes), it is to be slowly raised, and then pinned by a corner to the edge of a shelf or table, and to facilitate the draining, a small piece of bibulous paper is to be attached to the corner from which the liquid drops. It is to remain suspended until dry.

160. One of the best formulæ for use with the brush is the following :—

1st sol.—Hydrochlorate of ammonia . 5 grs.
Distilled water . . . . . 1 ounce,
Iodide of potassium . . . ½ gr.

This solution may be applied at any time, no harm resulting from the paper being kept.

161. 2nd sol.—A fifty-grain solution of ammonio-nitrate of silver, which may be made as follows :—Dissolve 50 grains of nitrate of silver in about three quarters of an ounce of distilled water, and when perfectly dissolved add, drop by drop, a solution of ammonia; this will at first cause it to become turbid, but by cautiously continuing the addition, it will again become clear. No more ammonia than is just sufficient to re-dissolve the precipitate should be added, and to be certain that no excess is present; a few drops of a fresh fifty-grain solution of nitrate of silver are to be added to render it again very slightly turbid. The whole should then be poured into a glass measure, and distilled water added to make up a measured ounce.

162. If there is any excess of ammonia, no care will enable one to obtain an even coating by brushing, the traces of the brush where last passed over coming out distinctly in printing. If, however, the correction is carried much too far, the print, although quite even, will be indifferent, and have an effect of colour in some cases very remarkable, the lighter parts of the picture coming out when finished of a greenish tone, while the shadows are brown.

163. This solution is to be brushed on in the same manner and quantity as the first solution of hydrochlorate of ammonia; and as soon as it is sufficiently dry to allow of its being hung up, it is either to be pinned to the edge of a shelf in a dark room, or, which is much better, thoroughly dried at a fire. The paper will not keep long after the application of the second solution;

for even if secluded from light and air, it will in the course of two or three days discolour.

164. If with this formula French (starch) papers are used, the colour of the finished proofs will be of a black tone; but with the English (gelatine) papers, the colour will be a rich brown.

165. The use of ammonio-nitrate of silver has been, without reason much attacked of late, on account of the supposed want of permanency of proofs procured by its means. This the writer ventures to think is an error, most of the blame it has been visited with being due either to the use of old and acid baths of hyposulphite, or, which is quite as frequent, the carelessness of operators themselves in washing out the solutions imperfectly; and he thinks if a comparison is instituted between proofs obtained by the same operator by this and any other process, it will be found that the defective ones will be equally distributed among them, the balance being perhaps in favour of albumen; not, however, from its giving really more permanent proofs, but that from the nature of its surface it repels moisture better than the others, and so is less open to injury.

166. Another good formula for use with the brush is the following:—

1st sol.	Chloride of ammonium .	8 gr.
	Iodide of potassium . . .	½ „
	Distilled water	1 oz.
2nd sol.	Nitrate of silver . . .	80 gr.
	Distilled water	1 ounce.

N. B. Paper prepared by this formula will keep much longer than by the last.

167. For floating, it is necessary to have a larger proportion of chloride than for brushing. The following answers well.

1st sol.	Chloride of ammonium .	20 grains,
	Iodide of potassium . .	½ grain,
	Distilled water	1 ounce,

2nd sol. Nitrate of silver . . . 90 grains,
Distilled water . . . . 1 ounce.

168 The same time should be allowed for floating, both on the chloride and on the silver, a longer time to either being equivalent to a larger dose. If the proofs when finished are too brown, a shorter time on the silver or a longer on the chloride will produce a blacker tint.

169. There remains now only to mention albumenized paper, which, as affording positives of high finish with but little experience, has met with much favour. One of the many formulæ for its application that have been recommended is the following :

170. Take any quantity of the whites of eggs, and add to it three times its bulk of distilled water, then to the mixture add hydrochlorate of ammonia in the proportion of 20 grains, and iodide of potassium in the proportion of half a grain to each measured ounce. The whole is then to be well beaten with a silver fork, or, what is much better, placed in a porcelain egg-beater and well shaken. By allowing it to remain at rest for twelve hours, all the fibrous portions will sink to the bottom, and the limpid upper portion can be decantered off for use. It may be applied by floating. The papers best suited for albumenizing, are the thin French and German. English kinds have not answered in the writer's hands.

171. When dry, the paper should be ironed with a moderately hot iron, previously placing it between two sheets of clean smooth paper, and should then be laid by in a dry place : it will keep for any length of time.

172. When required for use it may be made sensitive by floating it on the following solution :—

Nitrate of silver . . 70 grains,
Glacial acetic acid . 2 minims,
Distilled water . . 1 ounce.

173. The time of floating on both these solutions is from two to three minutes.

FIXING THE PROOFS.

174. To fix the proofs which may be obtained by either of the foregoing methods except the last, the following solution, recommended by Le Gray, will be wanted.

Dissolve in a bottle—

Hyposulphite of soda 1 ounce,
Filtered water . . 5 ounces.

175. In another bottle dissolve 70 grains of nitrate of silver in about an ounce of water; when dissolved add 28 grains of chloride of sodium (common salt), also dissolved in a small quantity of water; allow the white precipitate to subside, and then decant as much of the liquid as possible, and place the precipitate upon a piece of glass or porcelain in the sun, taking care to stir it about with a glass rod, so that all may be thoroughly blackened. When this is done, put it into the solution of hyposulphite, in which it will dissolve.

176. The proofs should be carefully immersed in this bath, and be allowed to remain not less than an hour. If, however, they should have been so much over-printed as to require reducing still more, they may remain a longer time. After removal from this bath, they should be immersed for about ten minutes in a fresh solution of hyposulphite of the same strength as that just recommended, but without the chloride; they may be then well washed in a large dish of water for five or six hours, changing the water frequently during that time; they may then either be pinned up or hung over glass rods to dry, and should afterwards be smoothed with a warm iron.

177. By the process just given, very beautiful proofs of a neutral tint can be easily obtained; but if we wish for the additional security afforded by washing with hot water, we must sacrifice much of this beauty and be content with dull brown colours.

178. For the albumenized paper (and if desired for all the others,) the following fixing solution may be employed:—

Hyposulphite of soda . 1 ounce,
Distilled water . . . 5 ounces.

179. When the hyposulphite is dissolved, add two grains of chloride of gold previously dissolved in half an ounce of water; this will probably cause a precipitation of a small quantity of sulphur, which will have to be removed by filtering through bibulous paper. When clear, the solution will be ready for use. The proofs must be watched, and should be removed when the desired colour is obtained. They will at first become brown, but will gradually get blacker and blacker until they attain a rich purple. The change with a new solution goes on rapidly two or three hours sufficing for the black colours, but after a time as much as even twenty-four hours will be needed, still they *can* be reached by giving time so long as the hypo- has any solvent power left.

180. The proofs must be well washed, as before recommended, and if hot water is preferred, it may with more safety be used.

181. Although breaking through the writer's intention of mentioning only those methods of easy application, he cannot pass over Le Gray's very beautiful process for obtaining purple and black colours; but at the same time he would caution those who attempt its practice that, although perfect in the hands of those who have had experience, it is of all photographic processes one of the most difficult to manage successfully.

182. Paper prepared with plain nitrate of silver is better for this purpose than the ammonio-nitrate. The prints should be exposed much longer than for the ordinary method of fixing, in fact until the whitish parts are of a violet hue. After the proof has been so exposed, it is to be immersed in the following solution, taking care to move it about while in:—

Distilled water . . . . 2 ounces,
Chloride of gold . . . . 1 grain,
Pure hydrochloric acid . . 10 minims.

183. The picture clears immediately after immersion, becoming altogether lighter. When nearly light enough, it is to be washed in several waters to remove the acid, and then immersed in a bath of hyposulphite of the strength of one ounce of the hyposulphite to six of water, in which it is to remain not less than half an hour, it is then to be washed and dried as usual.

184. Very good results are to be obtained by reversing the application of these solutions; that is to say, by first overprinting the proof, then fixing in the hyposulphite, and then, after washings, immersing in the acid bath of gold, and again washing. Perhaps the last is the most secure of all methods of fixing.

185. We have now, from the first preparation of the glass to the final fixing of the proof, gone, it is hoped with sufficient care, through what is called the Collodion progress; and if, in his attempt, the writer should have succeeded at all in removing the obstacles which unavoidably accompany the study of an art involving chemical changes of great delicacy, he will have the satisfaction of thinking, that the time he has given to Photography has been better bestowed than if his own amusement or profit had been the sole result.

WEIGHTS AND MEASURES EMPLOYED.

In almost every instance the quantity of solid substances has been mentioned as so many grains, but where the ounce or dram is mentioned, the ounce of 480 grains and the dram of 60 grains is to be understood.

When fluids are mentioned the *measured* ounce is meant, and the ounce is divided into eight drams of sixty minims each.

SOLUTIONS REQUIRED FOR NEGATIVES.

Sensitive bath—

Nitrate of Silver	40 grains.
Alcohol 60°	30 minims.
Distilled Water	1 ounce.

Developing solution—

Pyrogallic acid	1 grain.
Acetic acid	5 minims.
Alcohol	10 minims.
Distilled water	1 ounce.

Silver solution for developing—

Nitrate of Silver	40 grains.
Distilled water	1 ounce.

Fixing solution—

Hyposulphate of soda . .	10 ounces.
Filtered water	20 ounces.

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